

PATENT ABSTRACTS OF JAPAN

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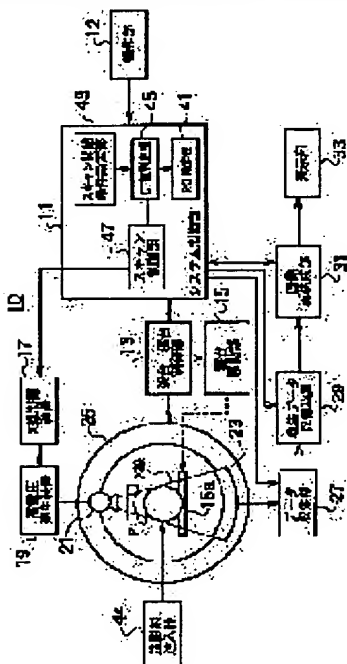
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(54) CT APPARATUS



(57)Abstract:

PROBLEM TO BE SOLVED: To collect inspection data for an object to be examined at an optimum contrasting timing by monitoring contrasting condition of the whole organs and monitoring different blood vessel groups.

SOLUTION: An ROI designating part 41 designates a plurality of concerned regions of an object P to be examined in the three-dimensional region based on the three-dimensional data of the object P to be examined and a scan starting condition setting part 43 sets a scan starting condition for starting an inspection scan and a CT value judging part 45 judges whether CT values in a plurality of concerned regions designated by the ROI designating part 41 after a contrasting agent is poured into the object P to be examined reach the scan starting condition set by the scan starting condition setting part 43. Then, a scan control part 47 starts the inspection scan of the object P to be examined when the CT values in a plurality of the concerned regions reach the scan starting condition.

CLAIMS

[Claim(s)]

[Claim 1] The X-ray CT scanner characterized by to have an assignment means specify two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte, a monitor means supervise CT value change of two or more of said areas of interest specified by said assignment means after pouring a contrast medium into said analyte, and the scanning control means that make the inspection scan of said analyte start based on CT value change of two or more of said areas of interest supervised by this monitor means.

[Claim 2] It is the X-ray CT scanner according to claim 1 which judges whether said monitor means reached the scanning start condition to which it was set beforehand for the CT valve of two or more of said areas of interest specified by said assignment means to start said inspection scan, and is characterized by said scanning control means making the inspection scan of said analyte start when the CT valve of two or more of said areas of interest reaches said scanning start condition.

[Claim 3] Said three-dimension data are an X-ray CT scanner according to claim 1 characterized by being data obtained using the data or the flat-surface detector obtained using the two-dimensional detector by which two or more trains array was carried out in the helical data obtained by helical scan or the slice direction of said analyte.

[Claim 4] Said assignment means is an X-ray CT scanner according to claim 1 characterized by extracting a specific part and specifying said two or more areas of interest as the extracted specific part by comparing with the threshold which was able to define the CT valve of said three-dimension data beforehand.

[Claim 5] Said monitor means is an X-ray CT scanner according to claim 2 characterized by judging whether all the CT valves of two or more of said areas of interest exceeded the threshold defined beforehand as said scanning start condition.

[Claim 6] When said scanning start condition is set up according to the individual for every area of interest, said monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of interest was reached. Said scanning control means The X-ray CT scanner according to claim 2 characterized by making the inspection scan of said analyte start when the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest.

[Claim 7] The slit which is prepared between X line source and said analyte, and has the movable X-ray shield of two sheets along the slice direction of said analyte, The slit control means which controls width of face between X-ray shields of two sheets of said slit to carry out exposure of the X-ray from said X line source only to two or more slices corresponding to said two or more areas of interest while said monitor means is supervising CT value change, The X-ray CT scanner according to claim 1 characterized by preparation *****.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About a whole body X-ray CT scanner, especially this invention pours a contrast medium into the interior of analyte, and relates to the X-ray CT scanner which scans analyte to the optimal imaging timing.

[0002]

[Description of the Prior Art] Conventionally, in order to make ***** clear in an X-ray CT scanner, a contrast medium is poured into the interior of analyte, and the real PUREPPU scan which scans analyte to the optimal imaging timing is known.

[0003] In this real PUREPPU scan, first, 1 cross-section image of analyte is used, areas of interest (it

is hereafter called ROI for short.), such as the interior of this 1 cross section, for example, a main artery etc., are specified, and the CT value of that ROI is supervised.

[0004] And the CT value of the ROI goes up with the contrast medium poured into the interior of analyte, and when a threshold with the CT value is reached, it checks that the ROI has dyed enough with the contrast medium. Then, collection of the inspection data of analyte is started. Therefore, since it can scan to the optimal imaging timing, it is very effective in prehension of the positive imaging timing which does not depend on analyte.

[0005]

[Problem(s) to be Solved by the Invention] However, if it was in the conventional real PUREPPU scan, since the CT value of ROI only in one cross section of analyte was supervised, it was unobservable whether the whole field of an organ to observe dyed best with the contrast medium.

[0006] Moreover, when there were not the optimal arterial blood tubing for the exactly same cross-section image and a portal vein blood vessel for example, to observe an artery layer and a portal vein layer, it was difficult to supervise both arterial blood tubing and portal vein blood vessel to coincidence.

[0007] The purpose of this invention is by supervising the monitor of the imaging condition of the whole organ, and a different imaging condition of a blood vessel group to offer the X-ray CT scanner which can collect the inspection data of analyte to the optimal imaging timing.

[0008]

[Means for Solving the Problem] This invention was considered as the following configurations, in order to solve said technical problem. This invention is characterized by to have an assignment means specify two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte, a monitor means supervise CT value change of two or more of said areas of interest specified by said assignment means after pouring a contrast medium into said analyte, and the scanning control means that make the inspection scan of said analyte start based on CT value change of two or more of said areas of interest supervised by this monitor means.

[0009] When an assignment means specifies two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte according to this invention, a monitor means supervises CT value change of two or more areas of interest specified by the assignment means, after pouring a contrast medium into analyte, and a scanning control means makes the inspection scan of analyte start based on CT value change of two or more areas of interest supervised by the monitor means. That is, since two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.

[0010] Moreover, it judges whether said monitor means reached the scanning start condition to which it was set beforehand for the CT value of two or more of said areas of interest specified by said assignment means to start said inspection scan, and said scanning control means is characterized by making the inspection scan of said analyte start, when the CT value of two or more of said areas of interest reaches said scanning start condition.

[0011] Since it judges whether the monitor means reached the scanning start condition to which it was set beforehand for the CT value of two or more areas of interest specified by the assignment means to start an inspection scan, and a scanning control means makes the inspection scan of analyte start according to this invention when the CT value of two or more areas of interest reaches to a scanning start condition, it is collectable in the inspection data of analyte with the optimal imaging timing to the whole organ or a different blood vessel group.

[0012] Moreover, when said scanning start condition is set up according to the individual for every area of interest, said monitor means It judges whether the scanning start condition by which the CT value of the area of interest was set as the area of interest according to the individual for every area of interest was reached. Said scanning control means When the CT value of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, it is characterized by making the inspection scan of said analyte start.

[0013] According to this invention, when the scanning start condition is set up according to the

individual for every area of interest, a monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of interest was reached. A scanning control means Since the inspection scan of analyte is made to start when the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, the inspection data of analyte are collectable to the optimal imaging timing for every area of interest.

[0014] Moreover, it is prepared between X line source and said analyte, and is characterized by having the slit which has the movable X-ray shield of two sheets along the slice direction of said analyte, and the slit control means which controls width of face between X-ray shields of two sheets of said slit to carry out exposure of the X-ray from said X line source only to two or more slices corresponding to said two or more areas of interest while said monitor means is supervising CT value change.

[0015] While the monitor means is supervising CT value change according to this invention, since a slit control means controls width of face between X-ray shields of two sheets of a slit to carry out exposure of the X-ray from X line source only to two or more slices corresponding to two or more areas of interest, it can lessen the amount of exposures of the X-ray to analyte.

[0016]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the X-ray CT scanner of this invention is explained to a detail with reference to a drawing.

[0017] <Gestalt of the 1st operation> drawing 1 is the system configuration Fig. showing the outline configuration of the 1st of the X-ray CT scanner of the gestalt of operation of this invention. In drawing 1, X-ray CT scanner 10 of the gestalt of the 1st operation has the system control section 11, a control unit 12, a stand and a berth control section 13, the berth migration section 15, the X-ray control device 17, a high-voltage transformer assembly 19, the X-ray beam generation source 21, a detector 23, the rotation stand 25, the data collection section 27, the collection data storage 29, the image reconstruction section 31, and a display 33. This X-ray CT scanner 10 carries out exposure of the X-ray beam, rotating the X-ray beam generation source 21 around Analyte P.

[0018] Control units 12 are a mouse, a keyboard, etc. and input various kinds of information. The system control section 11 consists of central processing units (CPU) etc., and is outputted to a stand and the berth control section 13 by making into a stand and a berth control signal slice thickness inputted from the control unit 12, rotational speed, berth movement magnitude, etc. The system control section 11 outputs the X-ray beam generating control signal which controls X-ray beam generating to the X-ray control unit 17.

[0019] The system control section 11 outputs the detection control signal which shows the timing of detection of an X-ray beam to the data collection section 27. The system control section 11 outputs the data collection control signal for data collection to the data collection section 27.

[0020] A stand and the berth control section 13 output a berth migration signal to the berth migration section 15 while rotating the rotation stand 25 based on the stand and berth control signal which were outputted by the system control section 11.

[0021] The X-ray control device 17 controls the timing of high-voltage generating by the high-voltage transformer assembly 19 based on the X-ray beam generating control signal outputted by the system control section 11. A high-voltage transformer assembly 19 supplies the high voltage for carrying out exposure of the X-ray beam to the X-ray beam generation source 21 according to the control signal from the X-ray control section 17.

[0022] With the high voltage supplied from the high-voltage transformer assembly 19, the X-ray beam generation source 21 turns to analyte the flabellate form X-ray beam which had thickness in the slice direction, and it carries out exposure from many. Exposure of the detector 23 is carried out from the X-ray beam generation source 21, and it detects the X-ray beam which penetrated analyte.

[0023] Drawing 2 (a) is drawing which expressed the detector 23 in three dimension. A detector 23 consists of a two-dimensional detector by which has the sensing element of many channels and two or more arrays were carried out in the slice direction. About each train, the sensing element of about 1,000 channels is arranged in the shape of radii considering the focus of the X-ray beam generation source 21 as a core like the detector for single-slice CTs of drawing 2 (b).

[0024] The rotation stand 25 holds the X-ray beam generation source 21 and a detector 23. The

rotation stand 25 rotates by the stand rolling mechanism which is not illustrated centering on the revolving shaft which passes along the midpoint of the X-ray beam generation source 21 and a detector 23. In addition, while the X-ray beam generation source 21 and a detector 23 rotate the perimeter of analyte one time, it calls it one scanning actuation to collect the projection data of two or more slices (two or more cross sections) of analyte.

[0025] The data collection section 27 collects and outputs the projection data of two or more slices of analyte to coincidence based on the data collection control signal outputted by the system control section 11. The collection data storage 29 memorizes the projection data of two or more slices of the analyte collected by the data collection section 27.

[0026] The image reconstruction section 31 reconfigures two or more fault images of analyte to coincidence based on the projection data of two or more slices memorized by the collection data storage 29. A display 33 displays on a monitor two or more fault images of the analyte reconfigured in the image reconstruction section 31 on coincidence.

[0027] Moreover, the system control section 11 has the ROI specification part 41, the scanning start condition setting section 43, the CT valve judging section 45, and the scanning control section 47. The ROI specification part 41 specifies two or more ROIs in the three-dimension data based on two or more fault images of the analyte obtained in the image reconstruction section 31.

[0028] The scanning start condition setting section 43 sets up the scanning start condition for stopping the real PUREPPU scan which pours the contrast medium from the contrast-medium transfer pipet 44 into Analyte P, and is carried out, and usually starting a scan.

[0029] The CT valve judging section 45 judges whether the scanning start condition to which the CT valve of two or more ROIs specified in the ROI setting section 41 was set in the scanning start condition setting section 43 was filled.

[0030] The scanning control section 47 makes a scan usually start, when the CT valve of two or more ROIs fills a scanning start condition. Moreover, the scanning control section 47 performs X-ray exposure of a low dose with a real PUREPPU scan, and usually performs X-ray exposure of many dosage comparatively with a scan.

[0031] Next, the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 1st operation constituted in this way is explained, referring to the flow chart of drawing 3 R> 3.

[0032] First, by rotating the X-ray beam generation source 21 and the detector 23 for a multi-slice around Analyte P, the scan for ROI assignment is performed and the three-dimension data (volume data) of Analyte P are collected (step S11). This three-dimension data is volume data based on two or more fault images reconfigured in the image reconstruction section 431.

[0033] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve in the three-dimension data collected at step S11. For example, as shown in drawing 4, R1, R2, and R3 are specified as three ROIs in the organ 51 of the three-dimension data 50. Each of R1, R2, and R3 is covering two or more cross sections. Three ROIs are specified using a mouse etc. on the screen of a display 33 in fact.

[0034] In addition, about the specification method of ROI, the following two approaches can be illustrated, for example. The 1st approach sets up suitable window width to the CT valve of three-dimension data, and is an approach of specifying ROI using 3D image included in the set-up window width which extracted only the blood vessel section, for example. The 2nd approach is an approach of performing differential processing etc. to the CT valve of three-dimension data, performing edge detection, extracting the profile of only a certain organ, and specifying ROI.

[0035] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S13). As this scanning start condition, conditions as shown in drawing 5 (a) and drawing 5 (b) can be illustrated, for example.

[0036] In the example shown in drawing 5 (a), when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 into a threshold and a CT valve [in / for a CT valve / in / for the CT valve in R1 / CT1 and R2 / CT2 and R3] is set to CT3, let $CT1 > X0$, $CT2 > X0$, and $CT3 > X0$ be scanning start conditions. That is, it is contingent [on whether all of each of CT1, CT2, and CT3 exceeded the threshold X0].

[0037] In the example shown in drawing 5 (b), when you make an axis of ordinate into a CT valve,

you make an axis of abscissa into time amount and $X1$ is made into a threshold, let $1(CT12+CT22+CT32)/2 > X1$ be a scanning start condition. That is, it is contingent [on whether the square root of total of the square of each value of CT1 CT2, and CT3 exceeded the threshold $X1$].

[0038] In addition, you may be scanning start conditions other than a scanning start condition as shown in drawing 5 (a) and drawing 5 (b), and a suitable identifier is added, the scanning start condition is registered beforehand, and you may set up by reading the scanning start condition.

[0039] Next, after starting impregnation inside [of the contrast medium from the contrast-medium transfer pipet 44] analyte P (step S15), the scanning control section 47 sends out a low-dose control signal to the X-ray control unit 17, and makes a real PUREPPU scan carry out (step S17). With this real PUREPPU scan, the tube electric current mA of the X-ray beam generation source 21 is lowered rather than a scan, it can consider as a low dose or the amount of exposures to Analyte P can usually be lessened by using a special X-ray filter.

[0040] In addition, the scanning control section 47 may be synchronized with impregnation of the contrast medium from the contrast-medium transfer pipet 44, and may make a real PUREPPU scan start. In this case, when a contrast medium is poured in from the contrast-medium transfer pipet 44, the impregnation signal which shows impregnation of a contrast medium is sent out to the scanning control section 47, and the scanning control section 47 makes it synchronize with that impregnation signal, and should just make a real PUREPPU scan start. If it does in this way, a real PUREPPU scan can be certainly carried out to suitable timing.

[0041] Moreover, the scanning control section 47 may carry out exposure of the X-ray intermittently for a while by sending out an intermittent signal to the X-ray control unit 17. If it does in this way, the amount of exposures to Analyte P can be lessened.

[0042] Thus, the CT valve judging section 45 supervises whether the CT valve of two or more specified ROIs reached the scanning start condition (step S19). For example, in the example shown in drawing 5 (a), all of each CT valve of R1, R2, and R3 reach a threshold $X0$ in time of day $t1$. Moreover, in the example shown in drawing 5 (b), the square root of total of the square of each CT valve of R1, R2, and R3 reaches a threshold $X1$ in time of day $t2$.

[0043] Furthermore, when the CT valve of two or more specified ROIs reaches a scanning start condition, the scanning control section 47 carries out the usual scan of Analyte P (step S21). In this case, exposure of comparatively a lot of X-rays is carried out to Analyte P, and inspection data are collected.

[0044] Thus, two or more ROIs are specified using three-dimension data, and since X dosage is raised and a scan is usually started when the CT valve of two or more specified ROIs reaches a scanning start condition, the whole organ can collect inspection data to the timing which dyed best with the contrast medium. For this reason, ***** etc. can be made clearer.

[0045] In addition, drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 6 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 1st operation to drawing 7 is shown.

[0046] As shown in drawing 6 (a), if R1 is specified in organ 51a of one cross section S1 (one slice) and the CT valve of Rspecified 1 reaches a threshold $X0$ at time of day $t3$, by the conventional approach, a scan will usually be started. Since only one cross section is observed by this approach, at time of day $t3$, the CT valve of R2 is not ****(ed) to a threshold $X0$ so that drawing 7 (b) may also show. For this reason, the whole organ was collecting inspection data to the timing which does not fully dye.

[0047] On the other hand, as shown in drawing 7 (a), by the approach of the gestalt the 1st operation, R1, R2, and R3 are specified in organ 51b covering two or more cross sections, and a scan is usually started at the time of day $t4$ when all the CT valves of R1, R2, and R3 reached the threshold $X0$. For this reason, the whole organ can collect inspection data to the timing which dyed best with the contrast medium.

[0048] The X-ray CT scanner of <the gestalt of the 2nd operation>, next the gestalt of operation of the 2nd of this invention is explained. The X-ray CT scanner of the gestalt of the 2nd operation is characterized by collecting inspection data to the optimal imaging timing to each blood vessel group of a different blood vessel group. The three-dimension real PUREPPU processing by the X-ray CT

scanner of the gestalt of the 2nd operation is explained referring to the flow chart of drawing 8 .

[0049] First, the scan for ROI assignment is performed and the three-dimension data of Analyte P are collected (step S31).

[0050] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve out of collected three-dimension data. For example, as shown in drawing 9 , R4 is specified in the main artery 55 of the three-dimension data 50, and R5 is specified in an organ 53.

[0051] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S33). As a scanning start condition, conditions as shown in drawing 10 can be illustrated, for example.

[0052] In the example shown in drawing 10 , when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 and X1 into a threshold and a CT valve [in / for the CT valve in R4 / CT4 and R5] is set to CT5, make $CT4 > X0$ into the 1st scan start condition, and let $CT5 > X1$ be the 2nd scan start condition. In addition, it is good also considering $|CT4 - CT5| < X2$ as the 2nd scan start condition.

[0053] the [next, / for R4 as which the scanning control section 47 was specified after starting impregnation of the contrast medium from the contrast-medium transfer pipet 44 to the interior of analyte P (step S35)] -- 1 real PUREPPU scan is made to carry out (step S37)

[0054] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 4 reached the 1st scan start condition (step S39). As the CT valve of Rspecified 4 shows drawing 10 , when the 1st scan start condition is reached at time of day t5, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 1st inspection data (step S41).

[0055] the [next, / for R5 as which the scanning control section 47 was specified] -- 2 real PUREPPU scan is made to carry out (step S43)

[0056] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 5 reached the 2nd scan start condition (step S45). As the CT valve of Rspecified 5 shows drawing 10 , when the 2nd scan start condition is reached at time of day t6, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 2nd inspection data (step S47). In addition, only a count [need / step S43 to the step S47 / to be processed] is performed repeatedly.

[0057] Thus, since it judges whether the scanning start condition to which ROI was specified as each of two blood vessels, the scanning start condition was set up according to the individual for every ROI, and the CT valve of ROI was set to the ROI was reached, inspection data are collectable to two optimal different imaging timing.

[0058] In addition, you may carry out also in this case by synchronizing scanning initiation timing with the impregnation timing of the contrast medium from the contrast-medium transfer pipet 44, and exposure of the X-ray may be carried out intermittently.

[0059] Drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 11 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 2nd operation to drawing 12 is shown.

[0060] As shown in drawing 11 (a), if R4 (main artery) is specified in one cross section S2 (one slice) and the CT valve of Rspecified 4 reaches a threshold X0 at time of day t7, by the conventional approach, a scan (the 1st scan) will usually be started. By this approach, it is the optimal imaging timing for an artery layer. However, since only R4 is observed, the optimal imaging timing of a balanced layer or a portal vein layer is not known. For this reason, the imaging timing of a balanced layer or a portal vein layer was dependent on a way person's can, and experience. In addition, in drawing 11 (b), the time amount td from the end time of an artery layer to the start time of a balanced layer is the time amount depending on a way person's can, and experience.

[0061] On the other hand, as shown in drawing 12 (a), by the approach of the gestalt the 2nd operation, R4 (main artery) is specified in a blood vessel 55, R5 (portal vein) is specified in a blood vessel 53, when the CT valve of R4 reaches the 1st scan start condition at time of day t7, the 1st scan is started, and when the CT valve of R5 reaches the 2nd scan start condition at time of day t9, the 2nd scan is started. Therefore, inspection data are collectable to the imaging timing optimal about each of an artery layer, a portal vein layer, and a balanced layer.

[0062] The X-ray CT scanner of <the gestalt of the 3rd operation>, next the gestalt of operation of the

3rd of this invention is explained. Drawing 13 is the configuration block Fig. of the principal part of the X-ray CT scanner of the gestalt of the 3rd operation. This X-ray CT scanner is further characterized by having a slit 61 and the slit control section 63, as shown in drawing 13.

[0063] A slit 61 is formed between the X-ray beam generation source 21 and Analyte P, and has the movable X-ray shield of two sheets along the slice direction. The slit control section 63 controls width of face between X-ray shields of two sheets of a slit 61 based on two or more ROIs specified with the ROI specification part 41 in system control section 11a to carry out exposure of the X-ray only to two or more slices corresponding to two or more of these ROIs.

[0064] As shown in drawing 13, according to the constituted X-ray CT scanner, thus, the slit control section 63 in order [corresponding to R1 and R2 which were specified] to control width of face between X-ray shields of two sheets of a slit 61 to carry out exposure of X-ray FB only, for example to three slices, Since exposure of the X-ray is not carried out to the remaining parts of organs 57 other than R1 and R2, the unnecessary amount of exposures to Analyte P can be lessened.

[0065] In addition, this invention is not limited to the X-ray CT scanner of the gestalt of the 1st mentioned above thru/or the 3rd operation. With the gestalt of the 1st thru/or the 3rd operation, although the detector 23 for a multi-slice was used, as shown in drawing 14, three-dimension data may be collected using the flat-surface detector 65 by rotating the X-ray beam generation source 21 and the flat-surface detector 65 around Analyte P, for example.

[0066] Moreover, using detector 23a for a single slice as shown in drawing 2 (b), by moving berth 15a in the slice direction at a predetermined rate by the berth migration section 15, helical scan may be performed and the helical data obtained by helical scan, i.e., the three-dimension data of analyte, may be collected.

[0067]

[Effect of the Invention] Since according to this invention two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.

TECHNICAL FIELD

[Field of the Invention] About a whole body X-ray CT scanner, especially this invention pours a contrast medium into the interior of analyte, and relates to the X-ray CT scanner which scans analyte to the optimal imaging timing.

PRIOR ART

[Description of the Prior Art] Conventionally, in order to make ***** clear in an X-ray CT scanner, a contrast medium is poured into the interior of analyte, and the real PUREPPU scan which scans analyte to the optimal imaging timing is known.

[0003] In this real PUREPPU scan, first, 1 cross-section image of analyte is used, areas of interest (it is hereafter called ROI for short.), such as the interior of this 1 cross section, for example, a main artery etc., are specified, and the CT valve of that ROI is supervised.

[0004] And the CT valve of the ROI goes up with the contrast medium poured into the interior of analyte, and when a threshold with the CT valve is reached, it checks that the ROI has dyed enough with the contrast medium. Then, collection of the inspection data of analyte is started. Therefore, since it can scan to the optimal imaging timing, it is very effective in prehension of the positive imaging timing which does not depend on analyte.

EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, if it was in the conventional real PUREPPU scan, since the CT value of ROI only in one cross section of analyte was supervised, it was unobservable whether the whole field of an organ to observe dyed best with the contrast medium.

[0006] Moreover, when there were not the optimal arterial blood tubing for the exactly same cross-section image and a portal vein blood vessel for example, to observe an artery layer and a portal vein layer, it was difficult to supervise both arterial blood tubing and portal vein blood vessel to coincidence.

[0007] The purpose of this invention is by supervising the monitor of the imaging condition of the whole organ, and a different imaging condition of a blood vessel group to offer the X-ray CT scanner which can collect the inspection data of analyte to the optimal imaging timing.

MEANS

[Means for Solving the Problem] This invention was considered as the following configurations, in order to solve said technical problem. This invention is characterized by to have an assignment means specify two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte, a monitor means supervise CT value change of two or more of said areas of interest specified by said assignment means after pouring a contrast medium into said analyte, and the scanning control means that make the inspection scan of said analyte start based on CT value change of two or more of said areas of interest supervised by this monitor means.

[0009] When an assignment means specifies two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte according to this invention, a monitor means supervises CT value change of two or more areas of interest specified by the assignment means, after pouring a contrast medium into analyte, and a scanning control means makes the inspection scan of analyte start based on CT value change of two or more areas of interest supervised by the monitor means. That is, since two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.

[0010] Moreover, it judges whether said monitor means reached the scanning start condition to which it was set beforehand for the CT value of two or more of said areas of interest specified by said assignment means to start said inspection scan, and said scanning control means is characterized by making the inspection scan of said analyte start, when the CT value of two or more of said areas of interest reaches said scanning start condition.

[0011] Since it judges whether the monitor means reached the scanning start condition to which it was set beforehand for the CT value of two or more areas of interest specified by the assignment means to start an inspection scan, and a scanning control means makes the inspection scan of analyte start according to this invention when the CT value of two or more areas of interest reaches to a scanning start condition, it is collectable in the inspection data of analyte with the optimal imaging timing to the whole organ or a different blood vessel group.

[0012] Moreover, when said scanning start condition is set up according to the individual for every area of interest, said monitor means It judges whether the scanning start condition by which the CT value of the area of interest was set as the area of interest according to the individual for every area of

interest was reached. Said scanning control means When the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, it is characterized by making the inspection scan of said analyte start.

[0013] According to this invention, when the scanning start condition is set up according to the individual for every area of interest, a monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of interest was reached. A scanning control means Since the inspection scan of analyte is made to start when the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, the inspection data of analyte are collectable to the optimal imaging timing for every area of interest.

[0014] Moreover, it is prepared between X line source and said analyte, and is characterized by having the slit which has the movable X-ray shield of two sheets along the slice direction of said analyte, and the slit control means which controls width of face between X-ray shields of two sheets of said slit to carry out exposure of the X-ray from said X line source only to two or more slices corresponding to said two or more areas of interest while said monitor means is supervising CT value change.

[0015] While the monitor means is supervising CT value change according to this invention, since a slit control means controls width of face between X-ray shields of two sheets of a slit to carry out exposure of the X-ray from X line source only to two or more slices corresponding to two or more areas of interest, it can lessen the amount of exposures of the X-ray to analyte.

[0016]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the X-ray CT scanner of this invention is explained to a detail with reference to a drawing.

[0017] <Gestalt of the 1st operation> drawing 1 is the system configuration Fig. showing the outline configuration of the 1st of the X-ray CT scanner of the gestalt of operation of this invention. In drawing 1, X-ray CT scanner 10 of the gestalt of the 1st operation has the system control section 11, a control unit 12, a stand and a berth control section 13, the berth migration section 15, the X-ray control device 17, a high-voltage transformer assembly 19, the X-ray beam generation source 21, a detector 23, the rotation stand 25, the data collection section 27, the collection data storage 29, the image reconstruction section 31, and a display 33. This X-ray CT scanner 10 carries out exposure of the X-ray beam, rotating the X-ray beam generation source 21 around Analyte P.

[0018] Control units 12 are a mouse, a keyboard, etc. and input various kinds of information. The system control section 11 consists of central processing units (CPU) etc., and is outputted to a stand and the berth control section 13 by making into a stand and a berth control signal slice thickness inputted from the control unit 12, rotational speed, berth movement magnitude, etc. The system control section 11 outputs the X-ray beam generating control signal which controls X-ray beam generating to the X-ray control unit 17.

[0019] The system control section 11 outputs the detection control signal which shows the timing of detection of an X-ray beam to the data collection section 27. The system control section 11 outputs the data collection control signal for data collection to the data collection section 27.

[0020] A stand and the berth control section 13 output a berth migration signal to the berth migration section 15 while rotating the rotation stand 25 based on the stand and berth control signal which were outputted by the system control section 11.

[0021] The X-ray control device 17 controls the timing of high-voltage generating by the high-voltage transformer assembly 19 based on the X-ray beam generating control signal outputted by the system control section 11. A high-voltage transformer assembly 19 supplies the high voltage for carrying out exposure of the X-ray beam to the X-ray beam generation source 21 according to the control signal from the X-ray control section 17.

[0022] With the high voltage supplied from the high-voltage transformer assembly 19, the X-ray beam generation source 21 turns to analyte the flabellate form X-ray beam which had thickness in the slice direction, and it carries out exposure from many. Exposure of the detector 23 is carried out from the X-ray beam generation source 21, and it detects the X-ray beam which penetrated analyte.

[0023] Drawing 2 (a) is drawing which expressed the detector 23 in three dimension. A detector 23 consists of a two-dimensional detector by which has the sensing element of many channels and two or

more arrays were carried out in the slice direction. About each train, the sensing element of about 1,000 channels is arranged in the shape of radii considering the focus of the X-ray beam generation source 21 as a core like the detector for single-slice CTs of drawing 2 (b).

[0024] The rotation stand 25 holds the X-ray beam generation source 21 and a detector 23. The rotation stand 25 rotates by the stand rolling mechanism which is not illustrated centering on the revolving shaft which passes along the midpoint of the X-ray beam generation source 21 and a detector 23. In addition, while the X-ray beam generation source 21 and a detector 23 rotate the perimeter of analyte one time, it calls it one scanning actuation to collect the projection data of two or more slices (two or more cross sections) of analyte.

[0025] The data collection section 27 collects and outputs the projection data of two or more slices of analyte to coincidence based on the data collection control signal outputted by the system control section 11. The collection data storage 29 memorizes the projection data of two or more slices of the analyte collected by the data collection section 27.

[0026] The image reconstruction section 31 reconfigures two or more fault images of analyte to coincidence based on the projection data of two or more slices memorized by the collection data storage 29. A display 33 displays on a monitor two or more fault images of the analyte reconfigured in the image reconstruction section 31 on coincidence.

[0027] Moreover, the system control section 11 has the ROI specification part 41, the scanning start condition setting section 43, the CT valve judging section 45, and the scanning control section 47. The ROI specification part 41 specifies two or more ROIs in the three-dimension data based on two or more fault images of the analyte obtained in the image reconstruction section 31.

[0028] The scanning start condition setting section 43 sets up the scanning start condition for stopping the real PUREPPU scan which pours the contrast medium from the contrast-medium transfer pipet 44 into Analyte P, and is carried out, and usually starting a scan.

[0029] The CT valve judging section 45 judges whether the scanning start condition to which the CT valve of two or more ROIs specified in the ROI setting section 41 was set in the scanning start condition setting section 43 was filled.

[0030] The scanning control section 47 makes a scan usually start, when the CT valve of two or more ROIs fills a scanning start condition. Moreover, the scanning control section 47 performs X-ray exposure of a low dose with a real PUREPPU scan, and usually performs X-ray exposure of many dosage comparatively with a scan.

[0031] Next, the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 1st operation constituted in this way is explained, referring to the flow chart of drawing 3 R> 3.

[0032] First, by rotating the X-ray beam generation source 21 and the detector 23 for a multi-slice around Analyte P, the scan for ROI assignment is performed and the three-dimension data (volume data) of Analyte P are collected (step S11). This three-dimension data is volume data based on two or more fault images reconfigured in the image reconstruction section 431.

[0033] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve in the three-dimension data collected at step S11. For example, as shown in drawing 4, R1, R2, and R3 are specified as three ROIs in the organ 51 of the three-dimension data 50. Each of R1, R2, and R3 is covering two or more cross sections. Three ROIs are specified using a mouse etc. on the screen of a display 33 in fact.

[0034] In addition, about the specification method of ROI, the following two approaches can be illustrated, for example. The 1st approach sets up suitable window width to the CT valve of three-dimension data, and is an approach of specifying ROI using 3D image included in the set-up window width which extracted only the blood vessel section, for example. The 2nd approach is an approach of performing differential processing etc. to the CT valve of three-dimension data, performing edge detection, extracting the profile of only a certain organ, and specifying ROI.

[0035] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S13). As this scanning start condition, conditions as shown in drawing 5 (a) and drawing 5 (b) can be illustrated, for example.

[0036] In the example shown in drawing 5 (a), when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 into a threshold and a CT valve [in / for a

CT valve / in / for the CT valve in R1 / CT1 and R2 / CT2 and R3] is set to CT3, let $CT1 > X0$, $CT2 > X0$, and $CT3 > X0$ be scanning start conditions. That is, it is contingent [on whether all of each of CT1, CT2, and CT3 exceeded the threshold $X0$].

[0037] In the example shown in drawing 5 (b), when you make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount and $X1$ is made into a threshold, let

$1(CT1^2 + CT2^2 + CT3^2)/2 > X1$ be a scanning start condition. That is, it is contingent [on whether the square root of total of the square of each value of CT1 CT2, and CT3 exceeded the threshold $X1$].

[0038] In addition, you may be scanning start conditions other than a scanning start condition as shown in drawing 5 (a) and drawing 5 (b), and a suitable identifier is added, the scanning start condition is registered beforehand, and you may set up by reading the scanning start condition.

[0039] Next, after starting impregnation inside [of the contrast medium from the contrast-medium transfer pipet 44] analyte P (step S15), the scanning control section 47 sends out a low-dose control signal to the X-ray control unit 17, and makes a real PUREPPU scan carry out (step S17). With this real PUREPPU scan, the tube electric current mA of the X-ray beam generation source 21 is lowered rather than a scan, it can consider as a low dose or the amount of exposures to Analyte P can usually be lessened by using a special X-ray filter.

[0040] In addition, the scanning control section 47 may be synchronized with impregnation of the contrast medium from the contrast-medium transfer pipet 44, and may make a real PUREPPU scan start. In this case, when a contrast medium is poured in from the contrast-medium transfer pipet 44, the impregnation signal which shows impregnation of a contrast medium is sent out to the scanning control section 47, and the scanning control section 47 makes it synchronize with that impregnation signal, and should just make a real PUREPPU scan start. If it does in this way, a real PUREPPU scan can be certainly carried out to suitable timing.

[0041] Moreover, the scanning control section 47 may carry out exposure of the X-ray intermittently for a while by sending out an intermittent signal to the X-ray control unit 17. If it does in this way, the amount of exposures to Analyte P can be lessened.

[0042] Thus, the CT valve judging section 45 supervises whether the CT valve of two or more specified ROIs reached the scanning start condition (step S19). For example, in the example shown in drawing 5 (a), all of each CT valve of R1, R2, and R3 reach a threshold $X0$ in time of day $t1$.

Moreover, in the example shown in drawing 5 (b), the square root of total of the square of each CT valve of R1, R2, and R3 reaches a threshold $X1$ in time of day $t2$.

[0043] Furthermore, when the CT valve of two or more specified ROIs reaches a scanning start condition, the scanning control section 47 carries out the usual scan of Analyte P (step S21). In this case, exposure of comparatively a lot of X-rays is carried out to Analyte P, and inspection data are collected.

[0044] Thus, two or more ROIs are specified using three-dimension data, and since X dosage is raised and a scan is usually started when the CT valve of two or more specified ROIs reaches a scanning start condition, the whole organ can collect inspection data to the timing which dyed best with the contrast medium. For this reason, ***** etc. can be made clearer.

[0045] In addition, drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 6 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 1st operation to drawing 7 is shown.

[0046] As shown in drawing 6 (a), if R1 is specified in organ 51a of one cross section S1 (one slice) and the CT valve of Rspecified 1 reaches a threshold $X0$ at time of day $t3$, by the conventional approach, a scan will usually be started. Since only one cross section is observed by this approach, at time of day $t3$, the CT valve of R2 is not ****(ed) to a threshold $X0$ so that drawing 7 (b) may also show. For this reason, the whole organ was collecting inspection data to the timing which does not fully dye.

[0047] On the other hand, as shown in drawing 7 (a), by the approach of the gestalt the 1st operation, R1, R2, and R3 are specified in organ 51b covering two or more cross sections, and a scan is usually started at the time of day $t4$ when all the CT valves of R1, R2, and R3 reached the threshold $X0$. For this reason, the whole organ can collect inspection data to the timing which dyed best with the contrast medium.

[0048] The X-ray CT scanner of <the gestalt of the 2nd operation>, next the gestalt of operation of the 2nd of this invention is explained. The X-ray CT scanner of the gestalt of the 2nd operation is characterized by collecting inspection data to the optimal imaging timing to each blood vessel group of a different blood vessel group. The three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 2nd operation is explained referring to the flow chart of drawing 8.

[0049] First, the scan for ROI assignment is performed and the three-dimension data of Analyte P are collected (step S31).

[0050] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve out of collected three-dimension data. For example, as shown in drawing 9, R4 is specified in the main artery 55 of the three-dimension data 50, and R5 is specified in an organ 53.

[0051] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S33). As a scanning start condition, conditions as shown in drawing 10 can be illustrated, for example.

[0052] In the example shown in drawing 10, when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 and X1 into a threshold and a CT valve [in / for the CT valve in R4 / CT4 and R5] is set to CT5, make $CT4 > X0$ into the 1st scan start condition, and let $CT5 > X1$ be the 2nd scan start condition. In addition, it is good also considering $|CT4 - CT5| < X2$ as the 2nd scan start condition.

[0053] the [next, / for R4 as which the scanning control section 47 was specified after starting impregnation of the contrast medium from the contrast-medium transfer pipet 44 to the interior of analyte P (step S35)] -- 1 real PUREPPU scan is made to carry out (step S37)

[0054] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 4 reached the 1st scan start condition (step S39). As the CT valve of Rspecified 4 shows drawing 10, when the 1st scan start condition is reached at time of day t5, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 1st inspection data (step S41).

[0055] the [next, / for R5 as which the scanning control section 47 was specified] -- 2 real PUREPPU scan is made to carry out (step S43)

[0056] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 5 reached the 2nd scan start condition (step S45). As the CT valve of Rspecified 5 shows drawing 10, when the 2nd scan start condition is reached at time of day t6, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 2nd inspection data (step S47). In addition, only a count [need / step S43 to the step S47 / to be processed] is performed repeatedly.

[0057] Thus, since it judges whether the scanning start condition to which ROI was specified as each of two blood vessels, the scanning start condition was set up according to the individual for every ROI, and the CT valve of ROI was set to the ROI was reached, inspection data are collectable to two optimal different imaging timing.

[0058] In addition, you may carry out also in this case by synchronizing scanning initiation timing with the impregnation timing of the contrast medium from the contrast-medium transfer pipet 44, and exposure of the X-ray may be carried out intermittently.

[0059] Drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 11 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 2nd operation to drawing 12 is shown.

[0060] As shown in drawing 11 (a), if R4 (main artery) is specified in one cross section S2 (one slice) and the CT valve of Rspecified 4 reaches a threshold X0 at time of day t7, by the conventional approach, a scan (the 1st scan) will usually be started. By this approach, it is the optimal imaging timing for an artery layer. However, since only R4 is observed, the optimal imaging timing of a balanced layer or a portal vein layer is not known. For this reason, the imaging timing of a balanced layer or a portal vein layer was dependent on a way person's can, and experience. In addition, in drawing 11 (b), the time amount td from the end time of an artery layer to the start time of a balanced layer is the time amount depending on a way person's can, and experience.

[0061] On the other hand, as shown in drawing 12 (a), by the approach of the gestalt the 2nd operation, R4 (main artery) is specified in a blood vessel 55, R5 (portal vein) is specified in a blood vessel 53, when the CT valve of R4 reaches the 1st scan start condition at time of day t7, the 1st scan is started,

and when the CT valve of R5 reaches the 2nd scan start condition at time of day t9, the 2nd scan is started. Therefore, inspection data are collectable to the imaging timing optimal about each of an artery layer, a portal vein layer, and a balanced layer.

[0062] The X-ray CT scanner of <the gestalt of the 3rd operation>, next the gestalt of operation of the 3rd of this invention is explained. Drawing 13 is the configuration block Fig. of the principal part of the X-ray CT scanner of the gestalt of the 3rd operation. This X-ray CT scanner is further characterized by having a slit 61 and the slit control section 63, as shown in drawing 13.

[0063] A slit 61 is formed between the X-ray beam generation source 21 and Analyte P, and has the movable X-ray shield of two sheets along the slice direction. The slit control section 63 controls width of face between X-ray shields of two sheets of a slit 61 based on two or more ROIs specified with the ROI specification part 41 in system control section 11a to carry out exposure of the X-ray only to two or more slices corresponding to two or more of these ROIs.

[0064] As shown in drawing 13, according to the constituted X-ray CT scanner, thus, the slit control section 63 In order [corresponding to R1 and R2 which were specified] to control width of face between X-ray shields of two sheets of a slit 61 to carry out exposure of X-ray FB only, for example to three slices, Since exposure of the X-ray is not carried out to the remaining parts of organs 57 other than R1 and R2, the unnecessary amount of exposures to Analyte P can be lessened.

[0065] In addition, this invention is not limited to the X-ray CT scanner of the gestalt of the 1st mentioned above thru/or the 3rd operation. With the gestalt of the 1st thru/or the 3rd operation, although the detector 23 for a multi-slice was used, as shown in drawing 14, three-dimension data may be collected using the flat-surface detector 65 by rotating the X-ray beam generation source 21 and the flat-surface detector 65 around Analyte P, for example.

[0066] Moreover, using detector 23a for a single slice as shown in drawing 2 (b), by moving berth 15a in the slice direction at a predetermined rate by the berth migration section 15, helical scan may be performed and the helical data obtained by helical scan, i.e., the three-dimension data of analyte, may be collected.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the system configuration Fig. showing the outline configuration of the 1st of the X-ray CT scanner of the gestalt of operation of this invention.

[Drawing 2] It is drawing which expressed the detector in three dimension.

[Drawing 3] It is the flow chart which shows the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 1st operation.

[Drawing 4] It is drawing showing three ROIs specified in the organ.

[Drawing 5] It is drawing showing the scanning start condition of the gestalt of the 1st operation.

[Drawing 6] It is drawing explaining imaging timing with the conventional real PUREPPU scan.

[Drawing 7] It is drawing explaining imaging timing with the real PUREPPU scan of the gestalt of the 1st operation.

[Drawing 8] It is the flow chart which shows the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 2nd operation.

[Drawing 9] It is drawing showing ROI specified as each of a main artery and a portal vein.

[Drawing 10] It is drawing showing the scanning start condition of the gestalt of the 2nd operation.

[Drawing 11] It is drawing explaining imaging timing with the conventional real PUREPPU scan.

[Drawing 12] It is drawing explaining imaging timing with the real PUREPPU scan of the gestalt of the 2nd operation.

[Drawing 13] It is the configuration block Fig. of the principal part of the X-ray CT scanner of the gestalt of the 3rd operation.

[Drawing 14] It is drawing showing the X-ray CT scanner which collects three-dimension data using a flat-surface detector.

[Description of Notations]

10 [-- A stand and a berth control section,] -- An X-ray CT scanner, 11 -- The system control section, 12 -- A control unit, 13 15 [-- High-voltage transformer assembly,] -- The berth migration section, 15a -- A berth, 17 -- An X-ray control unit, 19 21 [-- Data collection section,] -- An X-ray beam generation source, 23 -- A detector, 25 -- A rotation stand, 27 29 [-- ROI specification part,] -- Collection data storage, 31 -- The image reconstruction section, 33 -- A display, 41 43 [-- A scanning control section, 61 / -- A slit, 63 / -- A slit control section, 65 / -- A flat-surface detector, P / -- Analyte, R1-R5 / -- ROI (area of interest).] -- The scanning start condition setting section, 44 -- Contrast-medium transfer pipet, 45 -- The CT valve judging section, 47

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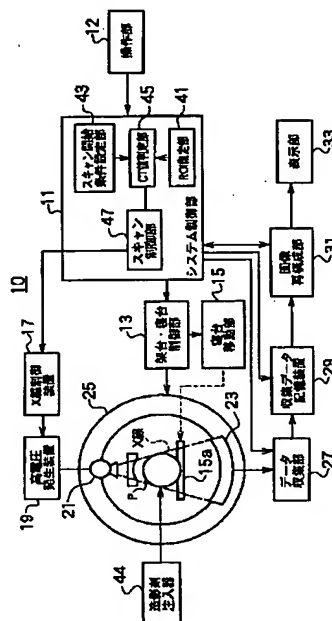
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(54) 【発明の名称】 X線CT装置

(57)【要約】

【課題】 臓器全体の造影状態の監視や異なる血管群の造影状態の監視を行うことにより最適な造影タイミングで被検体の検査データを収集する。

【解決手段】 ＲＯＩ指定部４１は、被検体Ｐの３次元データに基づく３次元領域内で被検体Ｐの複数の関心領域を指定し、スキャン開始条件設定部４３は、検査スキャンを開始するためのスキャン開始条件を設定し、ＣＴ値判定部４５は、被検体Ｐに造影剤を注入した後にＲＯＩ指定部４１により指定された複数の関心領域のＣＴ値がスキャン開始条件設定部４３で設定されたスキャン開始条件に達したかどうかを判定し、スキャン制御部４７は、複数の関心領域のＣＴ値がスキャン開始条件に達した場合に被検体Ｐの検査スキャンを開始させる。



【特許請求の範囲】

【請求項1】 被検体の3次元データに基づく3次元領域内で被検体の複数の関心領域を指定する指定手段と、前記被検体に造影剤を注入した後に前記指定手段により指定された前記複数の関心領域のCT値の変化を監視する監視手段と、

この監視手段により監視された前記複数の関心領域のCT値の変化に基づき前記被検体の検査スキャンを開始させるスキャン制御手段と、を備えることを特徴とするX線CT装置。

【請求項2】 前記監視手段は、前記指定手段により指定された前記複数の関心領域のCT値が前記検査スキャンを開始するための予め設定されたスキャン開始条件に達したかどうかを判定し、

前記スキャン制御手段は、前記複数の関心領域のCT値が前記スキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする請求項1記載のX線CT装置。

【請求項3】 前記3次元データは、ヘリカルスキャンにより得られたヘリカルデータまたは前記被検体のスライス方向に複数列配列された2次元検出器を用いて得られたデータまたは平面検出器を用いて得られたデータであることを特徴とする請求項1記載のX線CT装置。

【請求項4】 前記指定手段は、前記3次元データのCT値を予め定められたしきい値と比較することにより特定部位を抽出し、抽出された特定部位に前記複数の関心領域を指定することを特徴とする請求項1記載のX線CT装置。

【請求項5】 前記監視手段は、前記スキャン開始条件として、前記複数の関心領域の全てのCT値が予め定められたしきい値を越えたかどうかを判定することを特徴とする請求項2記載のX線CT装置。

【請求項6】 前記監視手段は、各関心領域毎に前記スキャン開始条件が個別に設定されている場合に、各関心領域毎にその関心領域のCT値がその関心領域に個別に設定されたスキャン開始条件に達したかどうかを判定し、

前記スキャン制御手段は、各関心領域毎にその関心領域のCT値がその関心領域に個別に設定されたスキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする請求項2記載のX線CT装置。

【請求項7】 X線源と前記被検体との間に設けられ、前記被検体のスライス方向に沿って移動可能な2枚のX線遮蔽板を有するスリットと、前記監視手段がCT値の変化を監視している間、前記複数の関心領域に対応した複数スライスの上に前記X線源からのX線を曝射するように前記スリットの2枚のX線遮蔽板相互間の幅を制御するスリット制御手段と、を備えることを特徴とする請求項1記載のX線CT装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、全身用X線CT装置に関し、特に、造影剤を被検体内部に注入し、最適な造影タイミングで被検体をスキャンするX線CT装置に関する。

【0002】

【従来の技術】従来、X線CT装置において、癌変部を明瞭にするために造影剤を被検体内部に注入し、最適な造影タイミングで被検体をスキャンするリアルブレップスキャンが知られている。

【0003】このリアルブレップスキャンにおいては、まず、被検体の一断面像を使用し、この一断面内部の例えば大動脈等の関心領域（以下、ROIと略称する。）を指定し、そのROIのCT値を監視する。

【0004】そして、被検体内部に注入された造影剤によりそのROIのCT値が上昇して、そのCT値がある閾値に達したとき、そのROIが造影剤により十分染まったことを確認する。その後、被検体の検査データの収集を開始する。従って、最適な造影タイミングでスキャンすることができるため、被検体に依らない確実な造影タイミングの捕捉に極めて有効である。

【0005】

【発明が解決しようとする課題】しかしながら、従来のリアルブレップスキャンにあつては、被検体の一断面のみにおけるROIのCT値を監視していたため、観察したい臓器の領域全体が造影剤により最も良く染まったかどうかを観察することができなかった。

【0006】また、例えば、動脈層と門脈層を観察したい場合に、ちょうど同じ断面像に最適な動脈血管、門脈血管がないときには、動脈血管と門脈血管との両者を同時に監視することは困難であった。

【0007】本発明の目的は、臓器全体の造影状態の監視や異なる血管群の造影状態の監視を行うことにより、最適な造影タイミングで被検体の検査データを収集することができるX線CT装置を提供することにある。

【0008】

【課題を解決するための手段】本発明は前記課題を解決するために以下の構成とした。本発明は、被検体の3次元データに基づく3次元領域内で被検体の複数の関心領域を指定する指定手段と、前記被検体に造影剤を注入した後に前記指定手段により指定された前記複数の関心領域のCT値の変化を監視する監視手段と、この監視手段により監視された前記複数の関心領域のCT値の変化に基づき前記被検体の検査スキャンを開始させるスキャン制御手段とを備えることを特徴とする。

【0009】この発明によれば、指定手段が被検体の3次元データに基づく3次元領域内で被検体の複数の関心領域を指定すると、監視手段は、被検体に造影剤を注入した後に指定手段により指定された複数の関心領域のCT値の変化を監視し、スキャン制御手段は、監視手段に

より監視された複数の関心領域のCT値の変化に基づき被検体の検査スキャンを開始させる。すなわち、3次元データで複数の関心領域を指定し、臓器全体の造影状態の監視と異なる血管群の造影状態の監視を行うため、臓器全体と異なる血管群に対して最適な造影タイミングで被検体の検査データを収集することができる。

【0010】また、前記監視手段は、前記指定手段により指定された前記複数の関心領域のCT値が前記検査スキャンを開始するための予め設定されたスキャン開始条件に達したかどうかを判定し、前記スキャン制御手段

は、前記複数の関心領域のCT値が前記スキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする。

【0011】この発明によれば、監視手段は、指定手段により指定された複数の関心領域のCT値が検査スキャンを開始するための予め設定されたスキャン開始条件に達したかどうかを判定し、スキャン制御手段は、複数の関心領域のCT値がスキャン開始条件に達した場合に被検体の検査スキャンを開始させるため、臓器全体と異なる血管群に対して最適な造影タイミングで被検体の検査データを収集することができる。

【0012】また、前記監視手段は、各関心領域毎に前記スキャン開始条件が個別に設定されている場合に、各関心領域毎にその関心領域のCT値がその関心領域に個別に設定されたスキャン開始条件に達したかどうかを判定し、前記スキャン制御手段は、各関心領域毎にその関心領域のCT値がその関心領域に個別に設定されたスキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする。

【0013】この発明によれば、監視手段は、各関心領域毎にスキャン開始条件が個別に設定されている場合に、各関心領域毎にその関心領域のCT値がその関心領域に個別に設定されたスキャン開始条件に達したかどうかを判定し、スキャン制御手段は、各関心領域毎にその関心領域のCT値がその関心領域に個別に設定されたスキャン開始条件に達した場合に被検体の検査スキャンを開始させるため、各関心領域毎に最適な造影タイミングで被検体の検査データを収集することができる。

【0014】また、X線源と前記被検体との間に設けられ、前記被検体のスライス方向に沿って移動可能な2枚のX線遮蔽板を有するスリットと、前記監視手段がCT値の変化を監視している間、前記複数の関心領域に対応した複数スライスのみに前記X線源からのX線を曝射するように前記スリットの2枚のX線遮蔽板相互間の幅を制御するスリット制御手段とを備えることを特徴とする。

【0015】この発明によれば、監視手段がCT値の変化を監視している間、スリット制御手段は、複数の関心領域に対応した複数スライスのみにX線源からのX線を曝射するようにスリットの2枚のX線遮蔽板相互間の幅

を制御するため、被検体へのX線の被曝量を少なくすることができる。

【0016】

【発明の実施の形態】以下、本発明のX線CT装置の実施の形態を図面を参照して詳細に説明する。

【0017】<第1の実施の形態>図1は、本発明の第1の実施の形態のX線CT装置の概略構成を示すシステム構成図である。図1において、第1の実施の形態のX線CT装置10は、システム制御部11、操作部12、架台・寝台制御部13、寝台移動部15、X線制御装置17、高電圧発生装置19、X線ビーム発生源21、検出器23、回転架台25、データ収集部27、収集データ記憶装置29、画像再構成部31、表示部33を有している。このX線CT装置10は、X線ビーム発生源21を被検体Pの回りに回転させながらX線ビームを曝射させるものである。

【0018】操作部12は、マウス、キーボード等であり、各種の情報を入力する。システム制御部11は、中央処理装置(CPU)等から構成され、操作部12から入力されたスライス厚、回転速度、寝台移動量等を架台・寝台制御部13に対して出力する。システム制御部11は、X線ビーム発生を制御するX線ビーム発生制御信号をX線制御装置17に対して出力する。

【0019】システム制御部11は、X線ビームの検出のタイミングを示す検出制御信号をデータ収集部27に対して出力する。システム制御部11は、データ収集のためのデータ収集制御信号をデータ収集部27に対して出力する。

【0020】架台・寝台制御部13は、システム制御部11により出力された架台・寝台制御信号に基づき回転架台25を回転させると共に、寝台移動信号を寝台移動部15に対して出力する。

【0021】X線制御装置17は、システム制御部11により出力されたX線ビーム発生制御信号に基づき、高電圧発生装置19による高電圧発生のタイミングを制御する。高電圧発生装置19は、X線ビームを曝射させるための高電圧をX線制御部17からの制御信号に従ってX線ビーム発生源21に供給する。

【0022】X線ビーム発生源21は、高電圧発生装置19から供給された高電圧によってスライス方向に厚みを持った扇状のX線ビームを被検体に向けて多方向から曝射する。検出器23は、X線ビーム発生源21から曝射され、被検体を透過したX線ビームを検出する。

【0023】図2(a)は、検出器23を3次元的に表した図である。検出器23は、多チャンネルの検出素子を有し且つスライス方向に複数配列された2次元検出器からなる。各列については、図2(b)のシングルスライスCT用検出器と同様に1,000チャンネル程度の検出素子がX線ビーム発生源21の焦点を中心として円

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弧状に配置される。

【0024】回転架台25は、X線ビーム発生源21と検出器23とを保持する。回転架台25は、図示しない架台回転機構により、X線ビーム発生源21と検出器23との中間点を通る回転軸を中心にして回転される。なお、X線ビーム発生源21と検出器23とが被検体の周囲を1回転しながら、被検体の複数スライス（複数断面）の投影データを収集することを1回のスキャン動作と称する。

【0025】データ収集部27は、システム制御部11により出力されたデータ収集制御信号に基づき被検体の複数スライスの投影データを同時に収集して出力する。収集データ記憶装置29は、データ収集部27によって収集された被検体の複数スライスの投影データを記憶する。

【0026】画像再構成部31は、収集データ記憶装置29に記憶された複数スライスの投影データに基づき被検体の複数の断面画像を同時に再構成する。表示部33は、画像再構成部31で再構成された被検体の複数の断面画像を同時にモニタ上に表示する。

【0027】また、システム制御部11は、ROI指定部41、スキャン開始条件設定部43、CT値判定部45、スキャン制御部47を有している。ROI指定部41は、画像再構成部31で得られた被検体の複数の断面画像に基づく3次元データの中に複数のROIを指定する。

【0028】スキャン開始条件設定部43は、造影剤注入器44からの造影剤を被検体Pに注入して実施されるリアルブレップスキャンを停止させて通常スキャンを開始するためのスキャン開始条件を設定する。

【0029】CT値判定部45は、ROI設定部41で指定された複数のROIのCT値がスキャン開始条件設定部43で設定されたスキャン開始条件を満たしたかどうかを判定する。

【0030】スキャン制御部47は、複数のROIのCT値がスキャン開始条件を満たした場合には、通常スキャンを開始させる。また、スキャン制御部47は、リアルブレップスキャンでは低線量のX線曝射を行い、通常スキャンでは比較的多線量のX線曝射を行う。

【0031】次にこのように構成された第1の実施の形態のX線CT装置による3次元リアルブレップ処理を図3のフローチャートを参照しながら説明する。

【0032】まず、X線ビーム発生源21とマルチスライス用の検出器23とを被検体Pの回りに回転させることにより、ROI指定用スキャンを行い、被検体Pの3次元データ（ボリュームデータ）を収集する（ステップS11）。この3次元データは、画像再構成部431で再構成された複数の断面画像に基づくボリュームデータである。

【0033】次に、ROI指定部41は、ステップS1

1で収集した3次元データの中にCT値を監視するための複数のROIを指定する。例えば、図4に示すように、3次元データ50の臓器51の中に3つのROIとしてR1、R2、R3を指定する。R1、R2、R3のそれぞれは、複数の断面に亘っている。3つのROIは、実際には表示部33の画面上でマウス等を用いて指定される。

【0034】なお、ROIの指定方法については、例えば、以下の2つの方法を例示することができる。第1の方法は、3次元データのCT値に対して適当なウィンドウ幅を設定し、設定されたウィンドウ幅に入る例えば、血管部のみを抽出した3D像を用いてROIを指定する方法である。第2の方法は、3次元データのCT値に対して微分処理等を施してエッジ検出を行い、ある臓器のみの輪郭を抽出してROIを指定する方法である。

【0035】次に、スキャン開始条件設定部43は、被検体Pの検査データ（通常スキャン）収集を開始するスキャン開始条件を設定する（ステップS13）。このスキャン開始条件としては、例えば、図5（a）や図5（b）に示すような条件を例示することができる。

【0036】図5（a）に示す例では、縦軸をCT値とし、横軸を時間とし、 X_0 をしきい値とし、CT1におけるCT値をCT1、R2におけるCT値をCT2、R3におけるCT値をCT3とした場合に、 $CT1 > X_0$ 、 $CT2 > X_0$ 、 $CT3 > X_0$ をスキャン開始条件とする。すなわち、CT1、CT2、CT3のそれぞれが全てしきい値 X_0 を越えたかどうかを条件とする。

【0037】図5（b）に示す例では、縦軸をCT値とし、横軸を時間とし、 X_1 をしきい値とした場合に、 $(CT1^2 + CT2^2 + CT3^2)^{1/2} > X_1$ をスキャン開始条件とする。すなわち、CT1、CT2、CT3のそれぞれの値の二乗の総和の平方根がしきい値 X_1 を越えたかどうかを条件とする。

【0038】なお、図5（a）、図5（b）に示すようなスキャン開始条件以外のスキャン開始条件であっても良く、また適当な名前を付加してスキャン開始条件を予め登録しておき、そのスキャン開始条件を読み出すことで設定しても良い。

【0039】次に、造影剤注入器44からの造影剤の被検体P内部への注入を開始した後（ステップS15）、スキャン制御部47は、X線制御装置17に対して低線量制御信号を送出し、リアルブレップスキャンを実施させる（ステップS17）。このリアルブレップスキャンでは、通常スキャンよりもX線ビーム発生源21の管電流mAを下げて低線量としたり、特殊なX線フィルターを用いることで、被検体Pへの被曝量を少なくすることができる。

【0040】なお、スキャン制御部47は、造影剤注入器44からの造影剤の注入に同期させて、リアルブレップスキャンを開始させてもよい。この場合、造影剤注入

器44から造影剤を注入したとき、造影剤の注入を示す注入信号をスキャン制御部47に送出し、スキャン制御部47がその注入信号に同期させてリアルブレップスキャンを開始させればよい。このようにすれば、適切なタイミングで確実にリアルブレップスキャンを実施することができる。

【0041】また、スキャン制御部47は、X線制御装置17に対して間欠信号を送出することにより、しばらくの間、X線を間欠的に曝射させても良い。このようにすれば、被検体Pへの被曝量を少なくすることができる。

【0042】このようにして、CT値判定部45は、指定された複数のROIのCT値がスキャン開始条件に達したかどうかを監視する(ステップS19)。例えば、図5(a)に示す例では、時刻 t_1 において、R1、R2、R3のそれぞれのCT値が全てしきい値 X_0 に達する。また、図5(b)に示す例では、時刻 t_2 において、R1、R2、R3のそれぞれのCT値の二乗の総和の平方根がしきい値 X_0 に達する。

【0043】さらに、指定された複数のROIのCT値がスキャン開始条件に達した場合には、スキャン制御部47は、被検体Pの通常スキャンを実施する(ステップS21)。この場合には、比較的多量のX線を被検体Pに曝射して検査データを収集する。

【0044】このように、3次元データを用いて複数のROIを指定し、指定された複数のROIのCT値がスキャン開始条件に達したときに、X線量を上げて通常スキャンを開始するので、臓器全体が造影剤により最も良く染まったタイミングで検査データを収集することができる。このため、癌変部等をより明瞭にすることができる。

【0045】なお、図6に従来のリアルブレップスキャンによる造影タイミングを説明する図を示す。図7に第1の実施の形態のリアルブレップスキャンによる造影タイミングを説明する図を示す。

【0046】図6(a)に示すように、従来の方法では、一断面S1(1スライス)の臓器51aの中にR1を指定し、指定されたR1のCT値が時刻 t_1 でしきい値 X_0 に達すると、通常スキャンを開始する。この方法では、一断面しか観察していないため、図7(b)からもわかるように、時刻 t_1 では、R2のCT値はしきい値 X_0 に達していない。このため、臓器全体が十分に染まらないタイミングで検査データを収集していた。

【0047】一方、図7(a)に示すように、第1の実施の形態の方法では、複数の断面に亘る臓器51bの中にR1、R2、R3を指定し、R1、R2、R3のCT値の全てがしきい値 X_0 に達した時刻 t_1 で、通常スキャンを開始する。このため、臓器全体が造影剤により最も良く染まったタイミングで検査データを収集することができる。

【0048】<第2の実施の形態>次に、本発明の第2の実施の形態のX線CT装置を説明する。第2の実施の形態のX線CT装置は、異なる血管群のそれぞれの血管群に対して、最適な造影タイミングで検査データを収集することを特徴とする。第2の実施の形態のX線CT装置による3次元リアルブレップ処理を図8のフローチャートを参照しながら説明する。

【0049】まず、ROI指定用スキャンを行い、被検体Pの3次元データを収集する(ステップS31)。

【0050】次に、ROI指定部41は、収集した3次元データの中から、CT値を監視するための複数のROIを指定する。例えば、図9に示すように、3次元データ50の大動脈55の中にR4を指定し、臓器53の中にR5を指定する。

【0051】次に、スキャン開始条件設定部43は、被検体Pの検査データ(通常スキャン)収集を開始するスキャン開始条件を設定する(ステップS33)。スキャン開始条件としては、例えば、図10に示すような条件を例示することができる。

【0052】図10に示す例では、縦軸をCT値とし、横軸を時間とし、 X_0 、 X_1 をしきい値とし、R4におけるCT値をCT4、R5におけるCT値をCT5とした場合に、CT4 $>$ X_0 を第1スキャン開始条件とし、CT5 $>$ X_1 を第2スキャン開始条件とする。なお、|CT4-CT5| $<$ X_2 を第2スキャン開始条件としても良い。

【0053】次に、造影剤注入器44から被検体P内部への造影剤の注入を開始した後(ステップS35)、スキャン制御部47は、指定されたR4のための第1リアルブレップスキャンを実施させる(ステップS37)。

【0054】そして、CT値判定部45は、指定されたR4のCT値が第1スキャン開始条件に達したかどうかを監視する(ステップS39)。指定されたR4のCT値が図10に示すように時刻 t_1 で第1スキャン開始条件に達した場合には、スキャン制御部47は、第1検査データを収集するために被検体Pの通常スキャンを実施する(ステップS41)。

【0055】次に、スキャン制御部47は、指定されたR5のための第2リアルブレップスキャンを実施させる(ステップS43)。

【0056】そして、CT値判定部45は、指定されたR5のCT値が第2スキャン開始条件に達したかどうかを監視する(ステップS45)。指定されたR5のCT値が図10に示すように時刻 t_2 で第2スキャン開始条件に達した場合には、スキャン制御部47は、第2検査データを収集するために被検体Pの通常スキャンを実施する(ステップS47)。なお、ステップS43からステップS47の処理は必要な回数だけ繰り返行われる。

【0057】このように、2つの血管のそれぞれにROI

Iを指定し、各ROI毎にスキャン開始条件を個別に設定し、ROIのCT値がそのROIに対して設定されたスキャン開始条件に達したかどうかを判定するため、異なる2つの最適な造影タイミングで、検査データを収集することができる。

【0058】なお、この場合においても、スキャン開始タイミングを造影剤注入器44からの造影剤の注入タイミングと同期させて行っても良く、また、間欠的にX線を曝射しても良い。

【0059】図11に従来のリアルブレップスキャンによる造影タイミングを説明する図を示す。図12に第2の実施の形態のリアルブレップスキャンによる造影タイミングを説明する図を示す。

【0060】図11(a)に示すように、従来の方法では、一断面S2(1スライス)の中にR4(大動脈)を指定し、指定されたR4のCT値が時刻 t でしきい値 X_c に達すると、通常スキャン(第1スキャン)を開始する。この方法では、動脈層には最適な造影タイミングである。しかし、R4しか観察していないため、平衡層や門脈層の最適な造影タイミングがわからない。このため、平衡層や門脈層の造影タイミングは、術者のカンと経験に依存していた。なお、図11(b)において、動脈層の終了時刻から平衡層の開始時刻までの時間 t_d が、術者のカンと経験に依存する時間である。

【0061】一方、図12(a)に示すように、第2の実施の形態の方法では、血管55の中にR4(大動脈)を指定し、血管53の中にR5(門脈)を指定し、R4のCT値が時刻 t で第1スキャン開始条件に達した場合に第1スキャンを開始し、R5のCT値が時刻 t で第2スキャン開始条件に達した場合に第2スキャンを開始する。従って、動脈層、門脈層、平衡層のそれぞれについて最適な造影タイミングで検査データを収集することができる。

【0062】<第3の実施の形態>次に、本発明の第3の実施の形態のX線CT装置を説明する。図13は、第3の実施の形態のX線CT装置の主要部の構成ブロック図である。このX線CT装置は、図13に示すように、さらに、スリット61、スリット制御部63を備えることを特徴とする。

【0063】スリット61は、X線ビーム発生源21と被検体Pとの間に設けられ、スライス方向に沿って移動可能な2枚のX線遮蔽板を有する。スリット制御部63は、システム制御部11a内のROI指定部41で指定された複数のROIに基づき、この複数のROIに対応した複数スライスのみX線を曝射するようにスリット61の2枚のX線遮蔽板相互間の幅を制御する。

【0064】このように構成されたX線CT装置によれば、図13に示すように、スリット制御部63は、指定されたR1とR2とに対応する例えば3つのスライスのみX線FBを曝射するようにスリット61の2枚のX

線遮蔽板相互間の幅を制御するため、R1、R2以外の臓器57の残りの部位にX線が曝射されないから、被検体Pへの不要な被曝量を少なくすることができる。

【0065】なお、本発明は前述した第1乃至第3の実施の形態のX線CT装置に限定されるものではない。第1乃至第3の実施の形態では、マルチスライス用の検出器23を用いたが、例えば、図14に示すように平面検出器65を用いて、X線ビーム発生源21と平面検出器65とを被検体Pの回りに回転させることにより、3次元データを収集してもよい。

【0066】また、図2(b)に示すようなシングルスライス用の検出器23aを用いて、寝台15aを寝台移動部15によりスライス方向に所定速度で移動させることによりヘリカルスキャンを行い、ヘリカルスキャンにより得られたヘリカルデータ、すなわち、被検体の3次元データを収集してもよい。

【0067】

【発明の効果】本発明によれば、3次元データで複数の関心領域を指定し、臓器全体の造影状態の監視や異なる血管群の造影状態の監視を行うため、臓器全体や異なる血管群に対して最適な造影タイミングで被検体の検査データを収集することができる。

【図面の簡単な説明】

【図1】本発明の第1の実施の形態のX線CT装置の概略構成を示すシステム構成図である。

【図2】検出器を3次元的に表した図である。

【図3】第1の実施の形態のX線CT装置による3次元リアルブレップ処理を示すフローチャートである。

【図4】臓器の中で指定された3つのROIを示す図である。

【図5】第1の実施の形態のスキャン開始条件を示す図である。

【図6】従来のリアルブレップスキャンによる造影タイミングを説明する図である。

【図7】第1の実施の形態のリアルブレップスキャンによる造影タイミングを説明する図である。

【図8】第2の実施の形態のX線CT装置による3次元リアルブレップ処理を示すフローチャートである。

【図9】大動脈と門脈とのそれぞれに指定されたROIを示す図である。

【図10】第2の実施の形態のスキャン開始条件を示す図である。

【図11】従来のリアルブレップスキャンによる造影タイミングを説明する図である。

【図12】第2の実施の形態のリアルブレップスキャンによる造影タイミングを説明する図である。

【図13】第3の実施の形態のX線CT装置の主要部の構成ブロック図である。

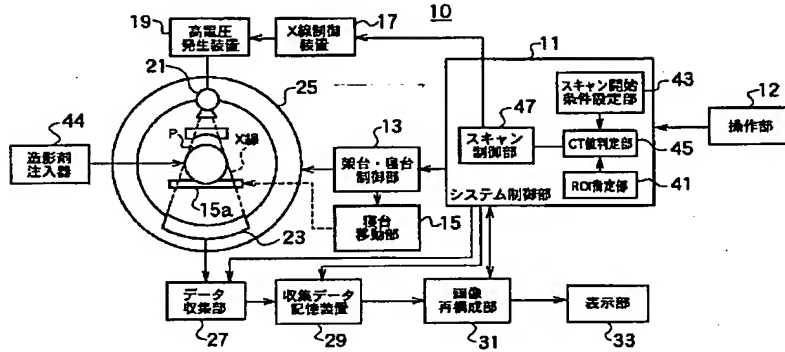
【図14】平面検出器を用いて3次元データを収集するX線CT装置を示す図である。

【符号の説明】

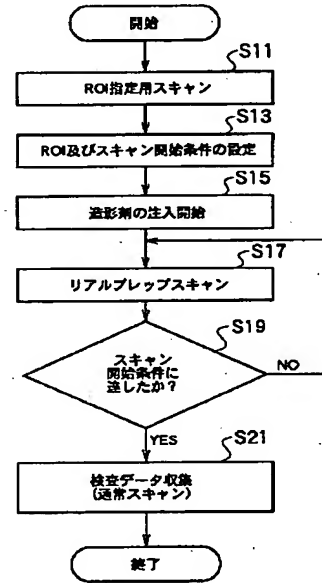
10…X線CT装置、11…システム制御部、12…操作部、13…架台・寝台制御部、15…寝台移動部、15a…寝台、17…X線制御装置、19…高電圧発生装置、21…X線ビーム発生源、23…検出器、25…回転架台、27…データ収集部、29…収集データ記憶装置、31…画像再構成部、33…表示部、41…ROI指定部、43…スキャン開始条件設定部、44…造影剤注入器、45…CT値判定部、47…スキャン制御部、61…スリット、63…スリット制御部、65…平面検出器、P…被検体、R1～R5…ROI（関心領域）。

* 置、31…画像再構成部、33…表示部、41…ROI指定部、43…スキャン開始条件設定部、44…造影剤注入器、45…CT値判定部、47…スキャン制御部、61…スリット、63…スリット制御部、65…平面検出器、P…被検体、R1～R5…ROI（関心領域）。

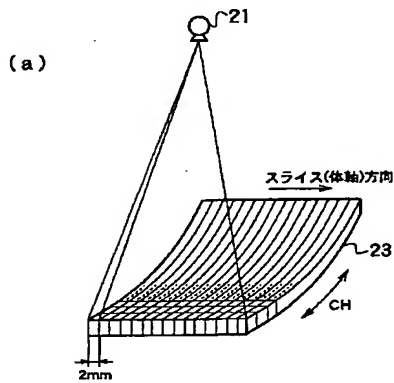
【図1】



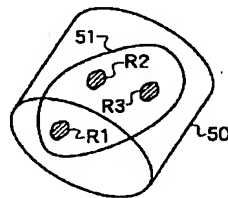
【図3】



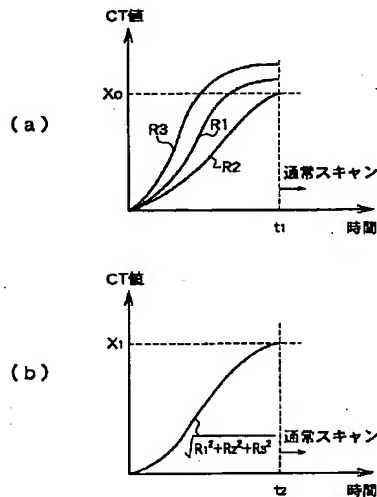
【図2】



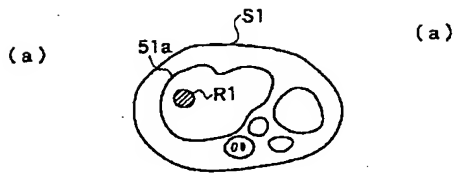
【図4】



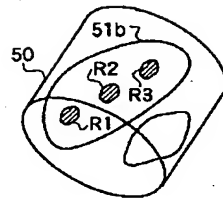
【図5】



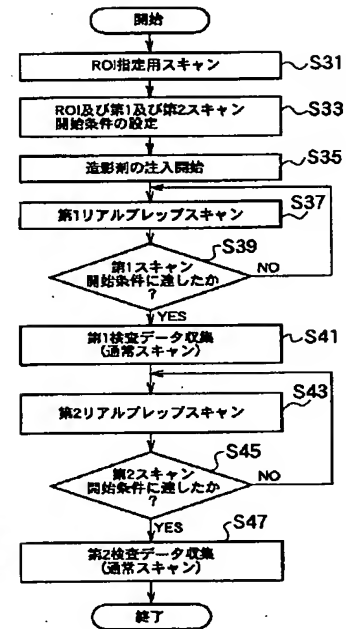
【図6】



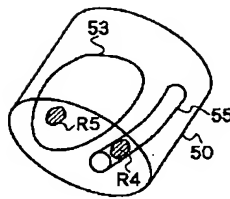
【図7】



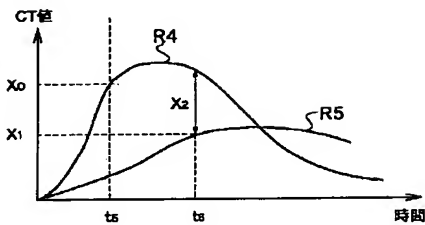
【図8】



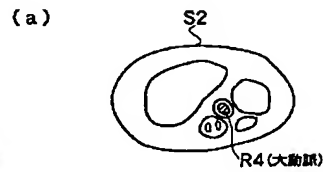
【図9】



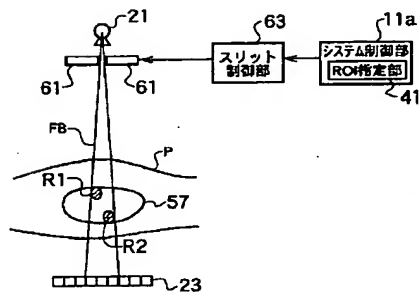
【図10】



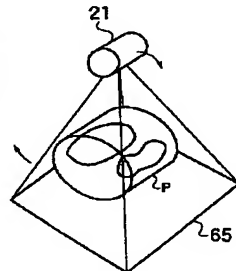
【図11】



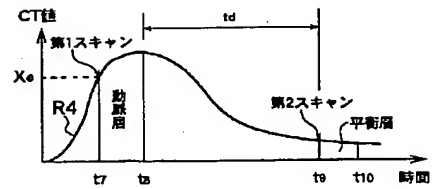
【図13】



【図14】

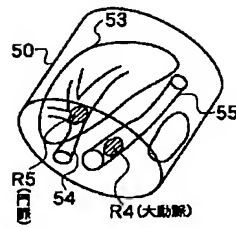


(b)

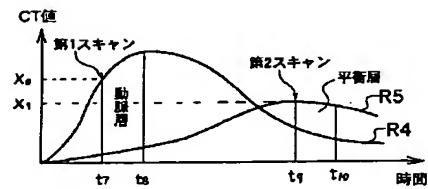


【図12】

(a)



(b)



フロントページの続き

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 EB18 FA19 FA20 FA34 FA36
 FA43 FD11 FF18 FF28 FF42